(No Model.) 3 Sheets—Sheet 1.

J. H. CHAMP.

HYDRAULIC AIR COMPRESSOR.

No. 513,556. Patented Jan. 30, 1894.

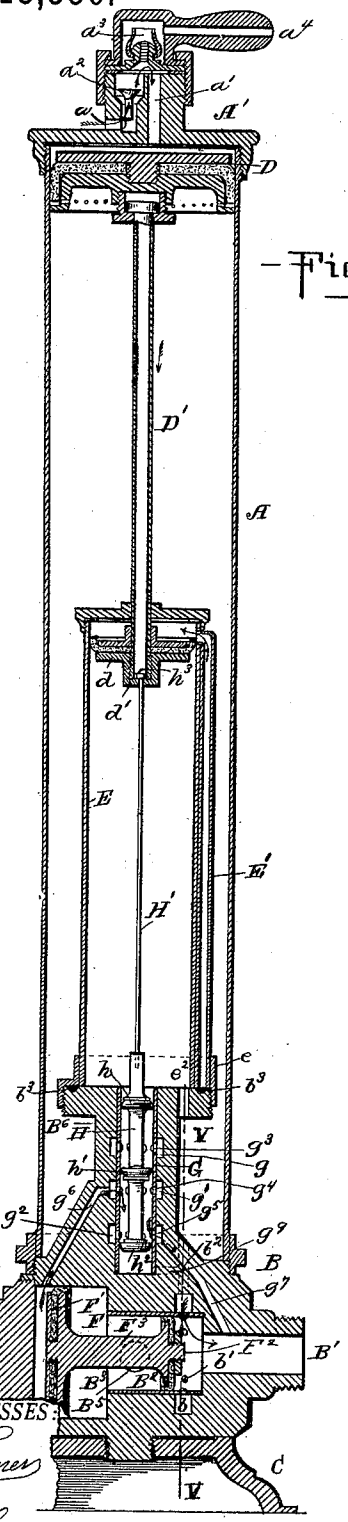

Fig I.

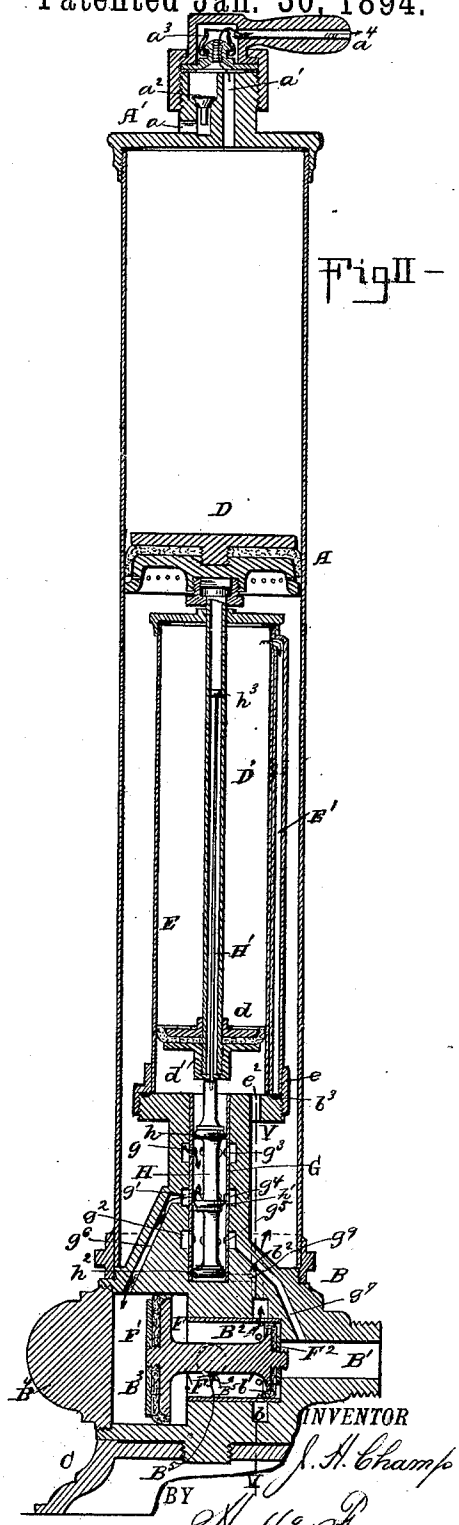

Fig II.

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3 Sheets—Sheet 2

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Fig. III.

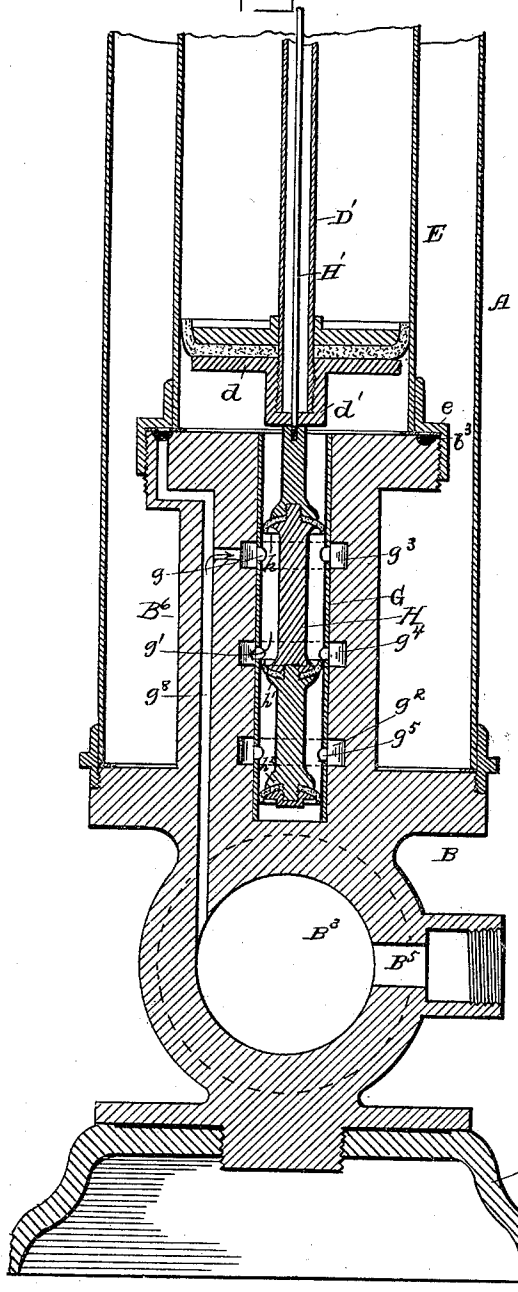

Fig. IV.

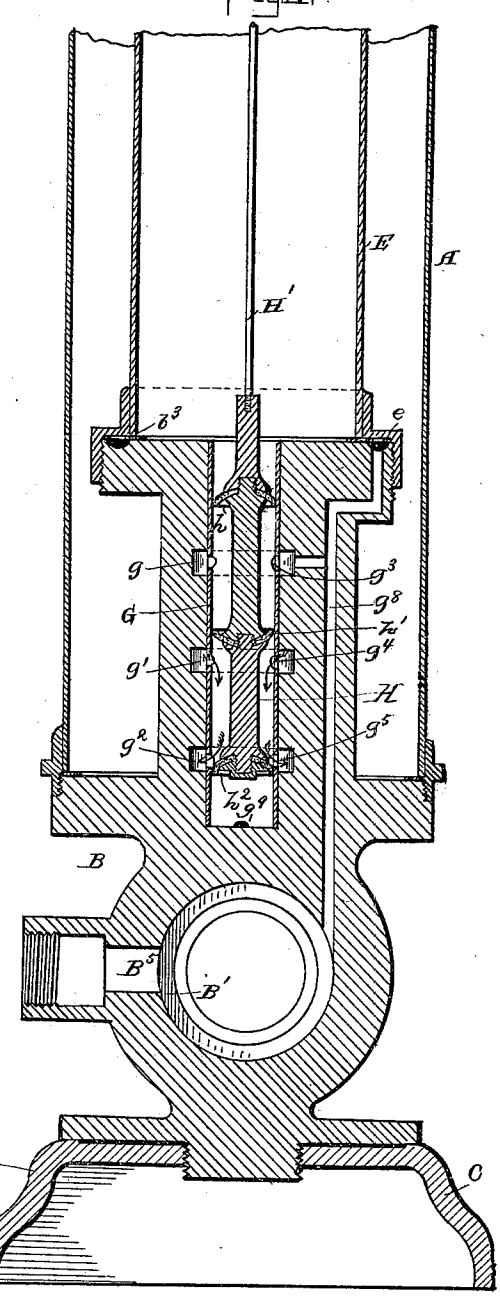

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Fig. V.

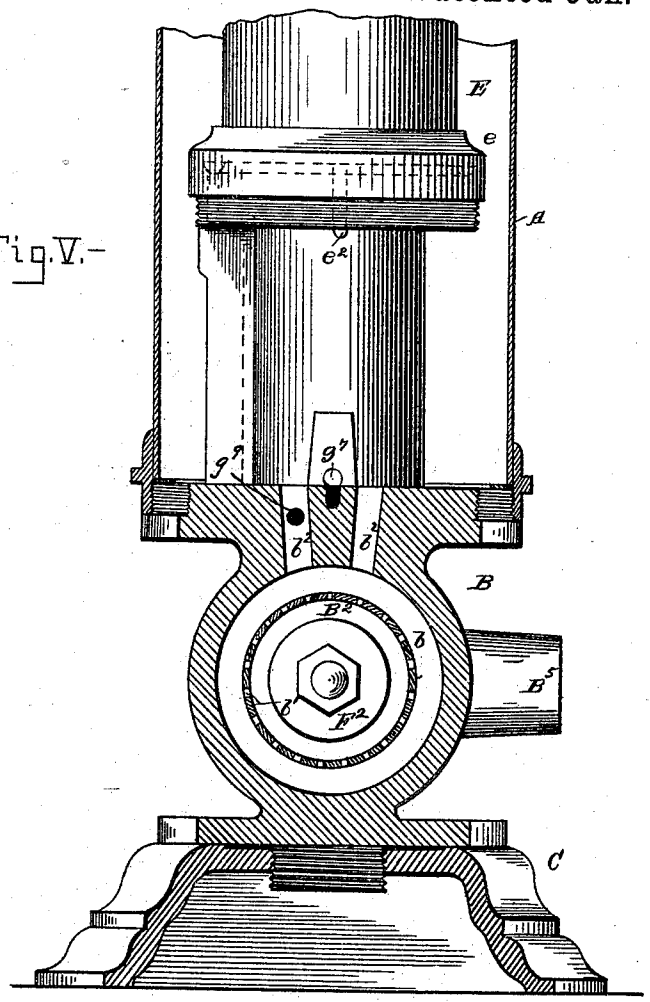
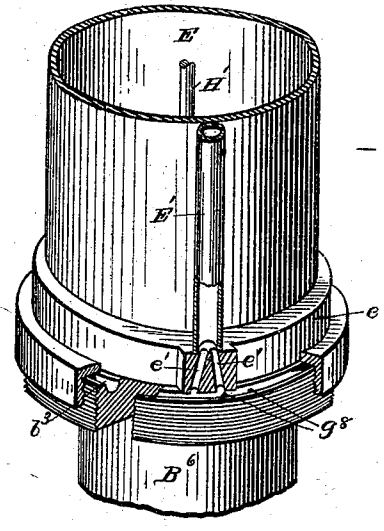


Fig. VI.



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UNITED STATES PATENT OFFICE.

JOSEPH H. CHAMP, OF CLEVELAND, OHIO, ASSIGNOR TO THE BISHOP & BABCOCK COMPANY, OF SAME PLACE.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 513,556, dated January 30, 1894.

Application filed March 21, 1891. Serial No. 385,893. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. CHAMP, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

In the annexed drawings Figure I represents a vertical section of my improved hydraulic air-compressor, showing the main-piston at the beginning of its down-stroke; Fig. II, a vertical section, showing the main-piston at the beginning of its up-stroke; Figs. III and IV, vertical sections taken at right angles to the former sections and looking in opposite directions; Fig. V, a detail vertical section taken through the channels for the main-cylinder on the lines V—V, Figs. I and II, and Fig. VI, a perspective view of the upper portion of the vertical extension of the valve-casing and of the lower portion of the inner or hydraulic returning-cylinder, parts being broken away and removed.

In the drawings the letter A indicates the main-cylinder which is mounted at its lower end upon the valve-casing B, which latter is suitably supported upon a base, C. The upper head A′ of the cylinder has an air-inlet, a, and an air-outlet, a', which are provided, respectively, with a suitable inlet-valve, a^2, and an outlet-valve, a^3. The air-outlet a' is, preferably, provided with a nozzle, a^4, to which the pipe, leading to the keg or barrel of beer or to whatever other vessel or place where compressed air may be required, may be attached.

A piston, D, which I may term the main or air-piston, fits and slides in the main-cylinder and has a tubular, downwardly-extending rod, D′, to the lower end of which is secured a piston, d, which fits and slides in a smaller, inner cylinder, E, which I may term the hydraulic returning-cylinder, and which is supported by a vertical extension, B^6, of the valve-casing in the lower half of the main-cylinder and communicating with the same through a channel, e^2, in the upper, enlarged end of said extension, which end forms the bottom of the hydraulic returning-cylinder.

The valve-casing B has an outlet-pipe or waste-pipe, B′, extending from one side; and has a small transverse bore, B^2, which is continued in said outlet and which forms a continuation of a large, transverse bore, B^3, the rear end of which is closed by a screw-plug, B^4; said bores, respectively, forming a small and a large valve-chamber. An annular chamber, b, is formed around the small valve-chamber B^2, and said chamber is formed with an annular row of perforations, b', or an annular slot, opening into the valve-chamber, and communicates with the main-cylinder by means of one or more channels, b^2. A water-controlling-valve, F, is formed with a large piston, F′, sliding in the large valve-chamber, with a small piston, F^2, sliding in the small valve-chamber, and with a connecting stem, F^3.

The inlet-opening B^5 for the valve-casing enters through the side of the same in the small valve-chamber B^2 and is at all times to the rear of the forward, small valve-piston F^2, irrespective of the position of the latter.

A vertical and cylindrical valve-chamber, G, is formed in the vertical extension B^6 of the valve-casing, communicating at its open, upper end with the smaller inside or hydraulic returning cylinder E; and said valve-chamber has three annular chambers, g, g' and g^2, respectively surrounding it near its upper end, at about its middle, and near its lower end, said chambers communicating with the interior of the valve-chamber by annular rows of perforations or ports, g^3, g^4, and g^5, or annular slots. The middle chamber g' communicates with the rear end of the large valve-chamber of the valve-casing through a channel, g^6, and the lower chamber communicates with the water-outlet or waste through a channel g^7. The upper, annular chamber g communicates with the water-inlet through a vertical channel, g^8, the lower end of which opens into the smaller valve-chamber of the valve-casing at a point permanently to the rear of the smaller piston of the controlling-valve F. The upper end of said vertical channel g^8 opens into an annular groove or channel, b^3, in the upper end of the vertical

extension of the valve-casing. The lower end of the inner, smaller cylinder or hydraulic returning-cylinder E has a flange, *e*, by means of which it is secured upon the vertical extension B^6, and said flange covers the groove or channel b^3 and thus forms a closed, annular chamber or channel. A pipe, E′, extends from the upper end of the hydraulic returning-cylinder and has its lower end secured in the foot-flange *e* of the cylinder and communicates with the annular channel or chamber b^3 through one or two openings, *e*′, formed in said foot-flange. By this construction the pipe E′ will at all times communicate with the vertical channel g^8 irrespective of its position relative to the same, so that the cylinder E may be screwed with its foot-flange upon the vertical extension of the valve-casing without the necessity of adapting the screw-threads of said flange or extension so as to bring the pipe E′ and the vertical channel to register, which would be a very difficult matter to accomplish. A small channel, g^9, is formed from the lower end of the vertical valve-chamber G to the water-channels b^2 between the cylinder and annular chamber *b*, so that the pressure from below in the valve-chamber may at all times be that of the surrounding water.

A shifting distributing-valve, H, is secured to the lower end of a valve-rod, H′, which slides within the tubular piston-rod D′, and said valve slides within the cylindrical valve-chamber G and is provided with three pistons or packings, *h*, *h*′ and h^2, so that, when the valve is raised, it may connect the middle and the lower, annular chambers, *g*′ and g^2, and, when the valve is lowered, may connect the middle and the upper, annular chambers, *g*′ and *g*, of the vertical valve-chamber G. This is accomplished by the fact that the upper piston is always above the upper row of holes g^3 and the lower piston is always below the lower row of holes g^5 in whatever position the valve may be. The valve H is balanced by having both ends of the vertical valve-chamber communicating directly with the actuating water, the upper end of the valve-chamber communicating with the lower end of the hydraulic returning-cylinder E, and the lower end of the valve-chamber communicating with the outer cylinder through the channels g^9 and b^2.

The upper end of the valve-rod H′ is provided with a head, h^3, which may be engaged by the contracted, lower end *d*′ of the hollow piston-rod D′ so that the valve may be raised when the piston D is at the upper extremity of its stroke and may be depressed when the piston is at the lower extremity of its stroke.

To explain the operation of the air-compressor I will assume that the actuating water is admitted to the valve-casing through the inlet, the water passing preferably through a suitable fluid regulator before entering the valve-casing and that the parts of the compressor are in the position illustrated in Fig. II of the drawings. The vertical distributing-valve has been depressed by the descending piston; and the water, which enters the valve-casing and passes up through the vertical channel g^8, passes from said vertical channel through the upper, annular chamber *g*, through the portion of the distributing-valve-chamber between the upper and middle pistons of the distributing-valve, into the middle, annular chamber *g*′, and through the rear channel g^6 into the rear end of the large valve-chamber when the valve F will be shifted forward. At the same time water passes up through vertical channel g^8, annular channel b^3, vertical pipe E′, into the hydraulic returning cylinder E above the small piston *d*. When the water-controlling-valve is shifted forward the inlet water will pass from the inlet-opening, through the valve-chamber and out through the exposed annular row of holes into the annular chamber *b*. Thence the water passes up through the channels b^2 into the cylinder, forcing the main-piston upward and expelling compressed air through the air-outlet. Water will also pass through the channel e^2 in the lower end of the hydraulic returning-cylinder, balancing the pressure upon the small piston *d* in the same, which piston is drawn upward by the large main-piston against the pressure of the water above the former. Said water escapes through the vertical pipe E′, through the annular channel at the lower end of the hydraulic returning-cylinder, through the vertical channel g^8 and into the valve-chamber where it mingles with the inlet-water. It is obvious from this, that water under the same pressure acts against both sides of the small returning-piston and the piston will thus be balanced and offer no resistance to the upstroke of the main-piston. When the main-piston arrives at the upper extreme of its stroke it will shift the vertical distributing valve by pulling upward upon the valve-rod, bringing all parts into the position illustrated in Fig. I. The raised distributing-valve will connect the rear channel g^6 and the forward waste-channel g^7 so that the water to the rear of the large valve-piston may waste and the water-controlling valve may be shifted rearward by the greater pressure of the inlet water upon the forward face of the large valve-piston. The shifted water-controlling valve will now have its small piston to the rear of the annular row of holes in the small valve-chamber, and the water in the main-cylinder and below the piston in the hydraulic returning-cylinder may freely escape. The inlet water will have no other escape from the valve-chamber except through the vertical channel g^3, and will pass up through the latter, through the annular channel b^3, through the vertical pipe E′, and into the upper end of the returning-cylinder E where it will force the hydraulic returning-piston down and, consequently, draw the main-piston down, causing it to accelerate the exhaust or waste of

the water beneath it. The main-piston will thus be positively operated by the actuating water at both strokes, up and down, and the compressor will, consequently, not be liable to stoppages caused by the failure of the piston to act, as is liable to happen in air-compressors where the piston is returned by its gravity or by some mechanical means, such as weights or springs. The action of the compressor will, on account of its having a positively-operated piston, be quicker than the action of the air-compressors in which the water acts as piston, and there will be no danger of the actuating water entering the air-pipes as the water and the air are separated from each other by the piston.

The water-controlling-valve is positively operated by water at its forward and back strokes and at the entire length of its strokes so that this valve will not be liable to fail to act.

The vertical distributing-valve is balanced by the actuating water from above and below and will, consequently, be easily shifted and will remain in whatever position it may be placed by the returning-piston and the contracted, lower end of the tubular main piston-rod.

Other modes of applying the principle of my invention may be employed for the mode herein explained. Change may therefore be made as regards the mechanism herein set forth, provided the principles of construction respectively recited in the following claims are employed.

I disclaim as my invention, the combination with a main casing having a valve chamber, a water controlling valve reciprocating therein, a hydraulic returning piston and piston chamber above said valve chamber, and water passages from one chamber to the other, of an air and water chamber provided with an air opening in its upper portion and a water passage in its lower portion communicating with the valve and piston chambers, and a diaphragm or piston separating the air and water in said chamber.

I also disclaim as my invention, the combination with a main casing having a valve chamber and valve, a hydraulic returning piston chamber and piston therein above said valve chamber and passages for the actuating fluid leading into said valve chamber and into the piston chamber behind the piston therein, of an air and water chamber having a diaphragm or piston connected with the hydraulic returning piston, and a water passage connecting the lower sides of the two pistons.

I also disclaim as my invention, the combination with a main cylinder provided with air and water inlets and outlets, and a piston reciprocating therein with air and water respectively on opposite sides thereof, of a hydraulic returning cylinder and piston within said main cylinder,—said two pistons being connected.

I also disclaim as my invention, the combination of a main cylinder having air inlets and outlets in one end and water inlets and outlets in the other end, a main piston separating the air and water in said cylinder, a hydraulic returning cylinder within the main cylinder and having a piston connected to the main piston, and a valve mechanism controlling the inlet and outlet of water in the cylinder.

What I claim is—

1. In a hydraulic air-compressor, the combination of a main-cylinder, a main-piston in said cylinder, a water-controlling valve-chamber formed with a water inlet and a water outlet and having a channel communicating with the main-cylinder, a reciprocating valve within said valve-chamber and provided with a large piston permanently to the rear of the water inlet and with a small valve-piston adapted to alternately connect the channel with the water inlet and outlet, a valve-chamber having an upper port connected to the water inlet, a middle port connected to the water controlling valve-chamber to the rear of the large piston, and a lower port connected to the water outlet, and a valve in said valve-chamber, connected to the main-piston and formed with pistons or packings alternately connecting the middle and upper ports and the middle and lower ports, substantially as set forth.

2. In a hydraulic air-compressor, the combination with the valve-casing extension formed with an annular channel, and a channel opening into the latter, of a cylinder having its foot-flange secured over said annular channel to close the same, and a pipe opening above said annular channel to communicate therewith, substantially as set forth.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 11th day of March, A. D. 1891.

JOS. H. CHAMP.

Witnesses:
THOS. B. HALL,
WM. SECHER.